habitats needs consideration, and particular attention should be given to Pen's (1983) observation that the swamp-side vegetation has poor stability and is easily degraded by environmental change or disturbance, such as that caused by grazing stock.

This swamp is small by comparison with others in the surrounding area, and maintains only a small population of water birds. However, like many other small, isolated wetlands, it provides the ideal breeding habitat for several species of waterfowl. It also represents a relatively undisturbed summer refuge on the coastal plain, where 67% of wetlands are lost through evaporation during the summer and the fauna of many of the other permanent wetlands are greatly disturbed by man's activities (Seddon 1972).

## REFERENCES


ANON. 1978. Wetlands of the south-west of Western Australia with special reference to the Busselton area. Department of Fisheries and Wildlife, Perth.

NORMAN, F.I., THOMPSON, L.W. and HAMILTON, J.G. 1979. Use of habitat and diurnal activity of Pacific black duck, chestnut teal and grey teal at Serendip, Victoria. *Emu* 79: 54-62.

PEN, L.J. 1983. Peripheral vegetation of the Swan and Canning estuaries 1981. Department of Conservation and Environment, Western Australia, Swan River Management Authority, Bulletin 113.

RIGGERT, T.L. 1966. A study of the wetlands of the Swan Coastal Plain being a pilot study of the wetlands of Western Australia with particular reference to their use by waterfowl. Department of Fisheries and Fauna, Western Australia.

SEDDON, G. 1972. *Sense of Place*, a response to an environment, the Swan Coastal Plain. University of Western Australia Press, Nedlands, Western Australia.


# INTRODUCTION OF THE YABBIE, *CHERAX DESTRUCTOR* (DECAPODA: PARASTACIDAE) INTO SOUTHWESTERN AUSTRALIA


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## INTRODUCTION

Representatives of the freshwater crayfish genus *Cherax* are conspicuous inhabitants of freshwater bodies, both natural and man-made, in the southwest of Western Australia (Shipway 1951; Riek 1967; Morrissy 1978a). Six species are recognised (Austin 1979; unpub.), five of which are endemic to the southwest: *C. crassimanus*, *C. glaber*, *C. preissii* (the koonac), *C. quinquecarinatus* (the gilgie) and *C. tenuimanus* (the marron). *Cherax destructor*, commonly known as the yabbie, has been introduced from the southeastern Australia. The introduction of the yabbie was first noted by Austin (1979) who referred then to the species as *C. albidus*, and Morrissy (1983) and Morrissy *et al.* (1984) have followed suit. Subsequent taxonomic studies have shown that *C. albidus* is a morphological variant of *C. destructor* and does not warrant separate specific recognition (Austin unpub.).

It is not widely realised that *C. destructor* has been introduced into the southwest because this species is generally confused with local *Cherax* species, particularly the koonac, *C preissii*. The objectives of this paper are to: (1) document the present distribution of *C. destructor* in the southwest of Western Australia; (2) indicate diagnostic morphological characteristics of the species; and (3) discuss the possible consequences of this and future introductions.

## DISTRIBUTION

The Western Australian Museum has records of *C destructor* from 12 localities in the southwest, the earliest of which is dated January 1966 for specimens collected from a farm dam near the wheatbelt town of Corrigin. As part of a study of the distribution of *Cherax* spp. in the southwest, conducted in 1981 and early 1982, I collected samples of *C. destructor* from a further 17 locations. From these 29 locality records (Figure 1), it can be seen that *C. destructor* has been widely transplanted throughout the wheatbelt zone of Western Australia,

extending from Bremer Bay in the south to just southeast of Geraldton in the north. Discussions with farmers indicates that the introduction of this species into farm dams, for domestic consumption, has been and still is a widespread practice. Thus, the distribution of collected specimens of *C. destructor* (Figure 1) undoubtedly under represents the extent to which this species has been transplanted.

At present *C. destructor* occurs almost exclusively in man-made dams or ponds. Five of the 12 samples in the Western Australian Museum are accompanied by habitat details and all were collected from farm dams. Of the 17 sites at which I collected *C. destructor*, all but two were artificially constructed freshwater bodies. One of these two, Lake Bryde, is a semi-permanent freshwater lake, lying outside the natural distribution of the native

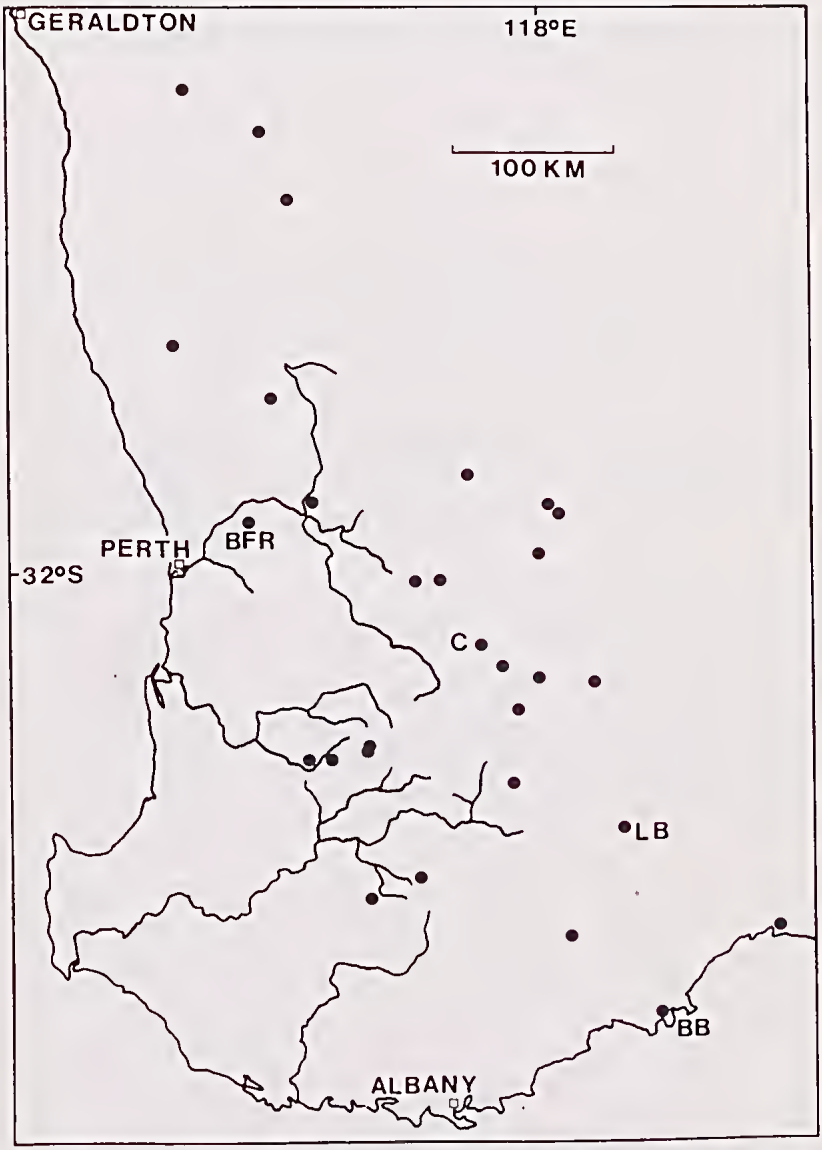


**Figure 1.** Locality records of *Cherax destructor* in south-western Australia. BFR, Banaring Fisheries Reserve; BB, Bremer Bay; C, Corrigin and LB, Lake Bryde.

species of *Cherax*. The other is at Banaring Fisheries Reserve where, in January 1982, I collected specimens of *C. destructor* and *C. quinquecarinatus* from a small creek, the first known collection of *C. destructor* together with a native species in a natural water body.

## IDENTIFICATION

People unfamiliar with crayfish taxonomy frequently confuse *C. destructor* with the native species *C. preissii* and *C. quinquecarinatus* (Figure 2). The salient morphological features by which *C. destructor* may be reliably identified are illustrated in Figures 3 and 4. Figure 3 shows the positions of the distinct mats of setae that occur on the inner margin of the carpus surrounding the carpal spine and on the ventral surface of the merus in *C. destructor*. These two segments of the chelae are devoid of setae in all the native southwestern species of *Cherax*. A second distinctive feature of *C. destructor* is the shape of the antennal scale. The inner margin of this appendage is broadly rounded distally in *C. destructor*, whereas in the local species the inner margin tapers more gradually to the point of the antennal scale (Figure 4).

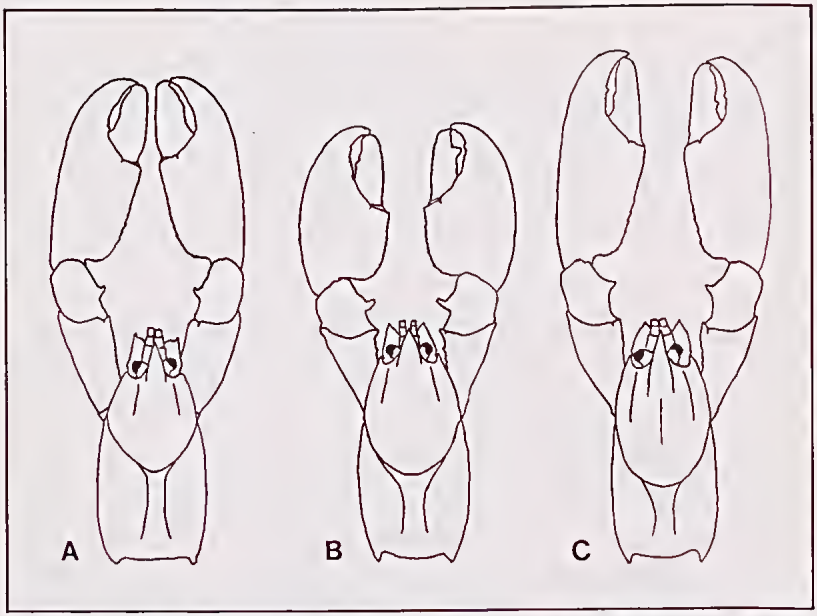


**Figure 2.** Outline diagrams of cephalothorax and chelae of male specimens of (a) *C. destructor* from Dandaragan, (b) *C. preissii* from Darkan and (c) *C. quinquecarinatus* from Cowaramup.

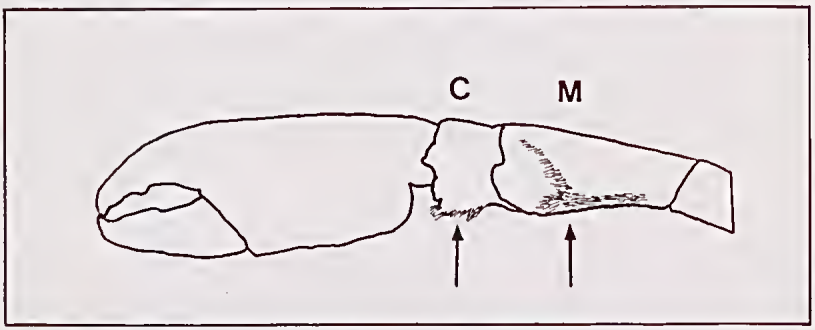


**Figure 3.** Ventral view of left chela of *C. destructor*. The positions of the distinctive mats of setae on the carpus (c) and merus (m) are indicated.

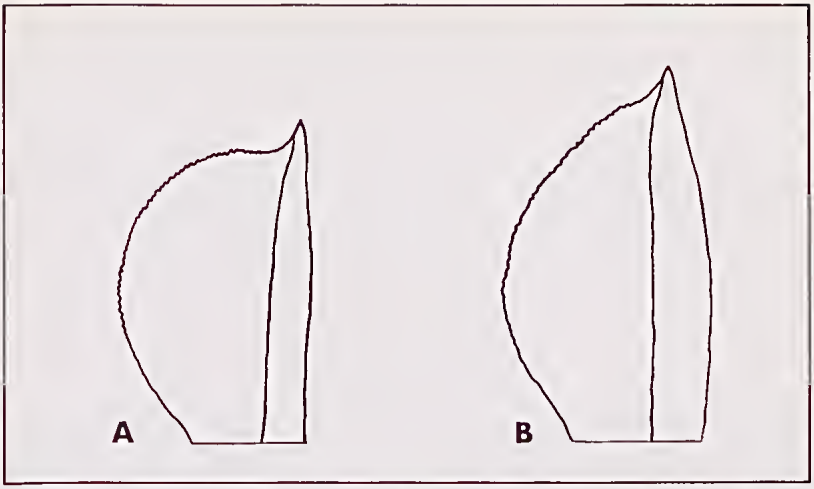


**Figure 4.** Comparison between the shape of the antennal scale of (a) *C. destructor* and (b) *C. preissii*.

## DISCUSSION

The frequent transplantation of freshwater crayfish of the northern hemisphere is primarily a consequence of the attention these animals attract as prized food items (Huner 1977; Wickens 1984). Likewise in Australia the two species of freshwater crayfish that have attracted considerable attention as potential candidates for aquaculture, *C. destructor* and *C. tenuimanus* (Morrissy 1983), have also been widely transplanted outside their natural ranges.

In addition to its introduction into Western Australia, *C. destructor* has been introduced to Tasmania (P. Horwitz pers. comm.) and has its range extended artifically in South Australia (Zeidler 1982). In Western Australia *C. tenuimanus* has been extensively transplanted beyond its natural range (Morrissy 1978a) and was introduced into Queensland and northern New South Wales in 1979 (R. Hutchings pers. comm.).

The large area over which *C. destructor* has been transplanted in the southwest of Western Australia reflects the success with which this species exploits farm dams. Similarly, in its natural environment *C. destructor* is considered to be an extremely successful species with the capacity to exploit a number of different habitats, ranging from semi-permanent swamps and billabongs to deeper, permanent streams and rivers (Frost 1975; Carroll 1981; Morrissy 1983; Austin unpub.). This range of habitats suggests that *C. destructor* may have the potential to compete with not only the small burrowing species of *Cherax* but possibly also the marron *(C. tenuimanus)*, a large riverine species which supports an important amateur fishery in the southwest of Western Australia (Morrissy 1978b). Indeed, it is considered that *C. destructor* has a negative effect upon growth and reproduction of *C. tenuimanus* in farm dams (Anon 1981).

At present, *C. destructor* in Western Australia appears to be restricted primarily to farm dam and man-made aquatic enviroments. However, because of the proximity of many of these waterbodies to the head waters of some of the major rivers in the southwest (Figure 1), it would seem highly probable than *C. destructor* will have the opportunity of penetrating into natural habitats, possibly at the expense of native species of *Cherax*. Although displacement of native species of freshwater crayfish by introduced species has not been documented in Australia, Capelli and Magnusen (1983) have recorded the displacement of *Orconectes viridis* by introduced *Orconectes* spp. in America.

On a more general level, introductions of exotic freshwater crayfish into natural environments are undesirable because they may alter the freshwater environment by their burrowing activities (Clark 1936), by increasing turbidity (Mills and McCloud 1983) or by destroying aquatic vegetation (Wickens 1984).

Introduced species ot freshwater crayfish have been classed as pests in several countries (Wickens 1984). There is also the possibility of the introduction of diseases (Unestam 1973). For example, a potentially serious microsporidian disease has been recorded from *C. destructor* (Carstairs 1979; Mills 1983) but not from the southwestern *Cherax* spp. to date. The likelihood of further transplantations of freshwater crayfish within Australia is high, given the increasing interest in the aquaculture of *C. destructor* and *C. tenuimanus* (Morrissy 1983) and the realisation that other *Cherax* spp. have potential for aquaculture (Austin unpub.). It is quite possible that further introductions of *C. destructor* will be made into Western Australia, particularly as it is not widely realised that this species has already been introduced.

It is clear that if native crayfish species are going to be adequately protected, greater control over the transportation of crayfish is needed and efforts must be made to contain existing introductions.

## ACKNOWLEDGEMENTS

I am grateful to Drs M.S. Johnson and B. Knott for comments on a draft of this paper. I would also like to thank the many people who have assisted me in the field, in particular, A. Boulton, B. Brittain, J. Goodsell and Dr B. Knott. Dr R.W. George kindly allowed me free access to the crustacean collection of the Western Australian Museum. This study was supported largely by funds provided by the Australian Biological Resources Study.

## REFERENCES

ANON, 1981. Marron of Western Australia. Department of Fisheries and Wildlife, Perth, Western Australia.

AUSTIN, C.M., 1979. Biochemical systematics of the genus *Cherax* (Decapoda : Parastacidae). Honours Thesis, Department of Zoology, University of Western Australia.

CAPELLI, G.M. and MAGNUSEN, J.J., 1983. Morphoedaphic and biogeographic analysis of crayfish distribution in northern Wisconsin. *J. Crust. Biol.* 3: 548-564.

CARROLL, P.N., 1981. Aquaculturalists' enthusiasm for yabbies highlights potential beyond the problems. *Aust. Fisheries* 40 (6): 23-31.

CARSTAIRS, I.L., 1979. Report of microsporidial infestation of the freshwater crayfish, *Cherax destructor*. *Comp. Biochem. Physiol.* 64B: 235-238.

CLARK, E., 1936. The freshwater and land crayfishes of Australia. *Mem. Natn. Mus. Melb. 10: 5-58.*

FROST, J.V., 1975. Australian crayfish. *Freshwater Crayfish* 2: 87-95.

HUNER, J.V., 1977. Introductions of the Louisiana Red Swamp Crayfish, *Procambarus clarkii* (Girard); an update. *Freshwater Crayfish* 3: 193-202.

MILLS, B.J., 1983. A review of diseases of freshwater crayfish, with particular reference to the yabbie, *Cherax destructor*. *Fish. Res. Rep.* 9: 1-18.

MILLS, B.J. and McCLOUD, P.I., 1983. Effects of stocking and feeding rates on experimental pond production of the crayfish *Cherax destructor* Clark (Decapoda : Parastacidae). *Aquaculture* 34: 51-72.

MORRISSY, N.M., 1978a. The past and present distribution of marron *Cherax teniumanus* (Smith) in Western Australia. *Fish. Res. Bull. West. Aust.* 22: 1-38.

MORRISSY, N.M., 1978b. The amateur marron fishery in southwestern Australia. *Fish. Res. Bull. West. Aust.* 21: 1-44.

MORRISSY, N.M., 1983. Crayfish research and industry activities in Australia. *Freshwater Crayfish* 5: 534-544.

MORRISSY, N.M., CAPUTI, N. and HOUSE, R.R., 1984. Tolerance of marron *(Cherax tenuimanus)* to hypoxia in relation to aquaculture. *Aquaculture* 41: 61-74.

RIEK, E.F., 1967. The freshwater crayfish of Western Australia (Decapoda : Parastacidae). *Aust. J. Zool. 15: 103-121.*

SHIPWAY, B., 1951. The natural history of the marron and other freshwater crayfish of southwestern Australia. *W. Aust. Nat.* 3: 7-12, 27-34.

UNESTAM, T., 1973. Significance of disease on freshwater crayfish. *Freshwater Crayfish* 1: 135-150.

WICKENS, J.F., 1984. Opportunities for farming crustaceans in western temperate regions. In: Muir, J.F. and R.J. Roberts (eds), *Advances in Aquaculture*. Croom Helm Ltd, pp. 87-177.

ZEIDLER, 1982. South Australian freshwater crayfish, *S.A. Nat.* 56: 36-42.